V. *A General Idea of the Structure of the Internal Parts of Fiſh. Communicated by Dr.* Charles Preſton.

FISH are not only different from other Animals' but likewiſe differ very much from one another' there being ſcarce a Species of them, that has not remarkable Differences: Not intending to enter into the ſeveral particularities, it ſhall ſuffice to obſerve the principal Matters wherein they differ from other Animals, of which the moſt conſiderable is their want of Lungs, and in their not Breathing; whereas all other Animals have Lungs both Terreſtrial, Volatil, and Amphibious: And in Inſects, the ſeveral Tracheæ that are ſpread throughout their whole Body ſerve them inſtead of Lungs. It is nevertheleſs neceſſary that ſomething ſhould ſupply this in fiſhes, which may have the ſame effect upon their Blood, as the Air has upon ours, by entring into our Lungs; that is to ſay, to divide and diſſolve it, and render it fit for Circulation; otherwiſe it were in danger of Coagulating, would become moveleſs and ſtagnate. Now we find no part in Fiſh more proper to produce this effect than the Bronchiæ that lye like ſo many Leaves upon each other under their Gills; for they receive the Water in by the Mouth, and return it by the Gills, or receiving it in by the they throw it out by the Mouth.

It may be asked, *What this is that diſſolves the Blood in the Bronchiæ?*

It is agreed upon by all, that the Water muſt neceſſarily contain this Body that produces the Effect; but they differ in aſſerting what it is. It cannot be Water alone,

alone, which is ſo far from diſſolving the Blood, that it rather Coagulates it; for it is found, that if an Injection of Water be made into the Lungs, the Blood will be Coagulated there, and the great coldneſs thereof permits us not to doubt of it; neither is it likely to be a Salt contained in the Water that may cauſe it; for it is not Marine Salt, ſince Fiſh live as well in Freſh Water as Salt; nor is it a Nitrous Salt, ſince they live in places where there is not a jot of it; it may yet be thought, that this Salt containing an Alkali, it mixes part thereof with the Blood of the Fiſhes that are in the Sea, which makes their Blood to be more diſſolved and fluid than that of Freſh Water Fiſh; and it is obſerved that Sea Fiſh are of a more cold Temperament than thoſe in Freſh Waters are.

It ſeems then to be the Air that is contained in the Water, that diſſolves the Blood in the Bronchiæ of Fiſh, as well as it does that in the Lungs of all other Animals. It cannot be doubted but that there is Air in all Water; the Experiment of that famous Perſon of the Academy, Monſieur *Marolle* has put this paſt diſpute: He ſet a Veſſel of Water over the Fire, ſo to drive out the Air from it; for the Bubbles that ariſe from hot Water, are only Air that breaks looſe from it, enveloped with ſome watery Particles. This Water he put in to the Air Pump, to draw out the Air from it; and after that filled a Vial with it, within Two or Three Fingers of the top, which ſpace he left full only of Air, and ſtopt the Viol well; and by ſhaking it, the Water Imbibed the Air, ſo as to riſe up and quite fill the Viol.

It may be objected, that if the Air in the Water were the cauſe of this effect, the Fiſh would live in the open Air. I ſhall only reply to this, that Fiſh have their Blood naturally leſs hot then ours, ſo that the natural

Heat of ours would be a Fever in them, and Mortal, wherefore we need not wonder they cannot live in the Air; for the Nitre of the pure Air is in too great a quantity, and too ſubtile, ſo that it diſſolves their Blood too much, and makes it too Fluid; whereas the Nitre in the Water is more groſs and in leſſer proportion, whence it gives their Blood only a Fluidity requiſite to keep it in its natural State: To prove that it is in the Bronchiæ that this diviſion is performed, we need but obſerve their extraordinary redneſs above any other part of the Body, a Proof that the Blood is there more divided: Fiſh are found to dye in Water Frozen over, which happens plainly from their Communication with the outward Air, being hindred by the Ice.

The Heart of Fiſh is different from that of other Animals in its having but One Ventricle; for it has only the *Vena Cava* and the *Aorta* that open into it, having no Lungs; ſo that by the *Aorta* the Blood comes out of the Heart, which is branched into a Thouſand Capillaries over the Bronchiæ, and is after re-united; which re-union is made under the Baſis of the Cranium; and becauſe the Blood, when once there, has no need of being forced higher upwards, they have no occaſion for a ſecond Ventricle for that purpoſe, as Terreſtrial Animals have.

The Re-union of theſe Capillaries of the Bronchiæ being made, they form Two large Trunks, of which one proceeds towards the Head, and the other towards the lower parts.

Fiſh have a Diaphragm, but not for the ſame purpoſe as in other Animals that Breath? it is always Strait and Tenſe, and Perpendicular on the Vertebræ, it hinders the fermenting Salts that exhale from the Inteſtines from coming to the Heart, which might cauſe ſome alteration there.

Their Stomach is Membranous; for Fiſh ſwallow down other ſmaller Fiſh whole, and ſometimes Earth; wherefore 'tis needful to have a power of Contracting and Straitning it ſelf, forceably to break to pieces the hard matters contained therein. Their Inteſtines make ſeveral great windings about; a ſign the Fermentation is but ſlow therein, which is made up by the length of the Inteſtines.

The Liver has much the ſame Situation as in other Animals, as alſo the Spleen has; they are provided of a Gall Bladder, a *Ductus Choledochus* and *Pancreas*, or rather Two little Bags faſtned to the Ventricle for the ſame uſe: As to the reſt of the Parts, Fiſh have uſually many Pancreas's, ſo that in ſome there have been told Forty Four; they have Kidneys, Bladder, *&c.*

They have the Ovary near the Vertebres of the Loins; the Eggs come forth at a paſſage below the *Anus*, and the Male has a like Ductus or Hole, by which they eject their Seed upon that of the Female to impregnate the Eggs, which the Male ſometimes changes the Colour of as he paſſes over them, when he caſts his Seed upon them after they are laid.

Fiſh have on the Vertebre of the Loins a Bladder, very large in proportion to their Bulk, which ſerves not for their Digeſtion, as Dr. *Needham* was of Opinion, for there is no Ductus found from this Bladder, leading to the Stomach; and if ſometimes ſuch a Ductus may be found, it permits the Liquor Syringed into it, to paſs from the Stomach to the Bladder, but not at all the other way from the Bladder

Bladder to the Stomach, which ſhews that Opinion not right. There is more reaſon to believe its uſe is by dilating it ſelf, to render the Fiſh lighter, as occaſion ſerves, for Swimming: So that when this Bladder is dilated, or the Air contained therein weighs leſs than an equal quantity of Water; if it be dilated a little, the Fiſh weighs as much as ſo much Water; and if it be compreſſed, the Fiſh weighs more than an equal quantity of Water; for the Air Compreſſed, weighs more than when 'tis Dilated. 'Tis a Rule in Hydroſtaticks, that a Body that weighs more than its equal Bulk of Water muſt ſink to the bottom; if it weighs leſs it will riſe to the top; if it weighs exactly equal to ſo much Water, it will ſtay where-ever 'tis placed. Now the Air of the Bladder, by being Compreſſed or Dilated, by means of the Muſcles of the Fiſh, cauſes the Fiſh to be more or leſs heavy. That it is this Bladder that makes the Fiſh Swim is plain; for if it be by any means burſt, ſo that it cannot be Extended, the Fiſh can no more raiſe it ſelf in the Water, but keeps continually at the bottom. The Fins and Tail aſſiſt them in their paſſage through the Water, whether they will; but the Dilatation of the Air in the Bladder makes them capable of Swimming after the ſame manner, as the Dilating of the Lungs and Thorax of a Man bears him up in the Water. Flat Fiſh, ſuch as Soles, have none of this Bladder; for they are able, by reaſon of their Breadth, to keep themſelves up in the Water. Cray-fiſh, and other Shell-fiſh want it likewiſe,

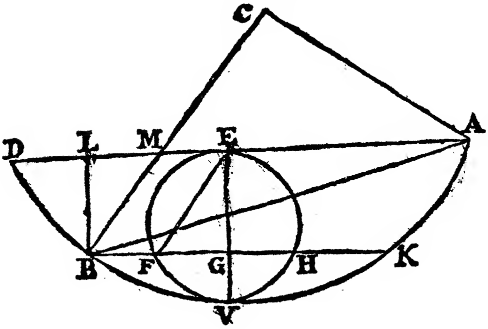
for

for the moſt part, for they creep only at the bottom of the Water; there are many Fiſh have them double.

VI. De Ratione Temporis quo grave labitur per rectam data duo puncta conjungentem, ad Tempus breviſſimum quo, vi gravitatis, tranſit ab horum uno ad alterum per arcum Cycloidis.

Theorema.

SI in Cycloide AVD *cujus baſis* AD *eſt horizonti parallela, Vertice* V *deorſum ſpectante, ex* A *ducatur utcunque recta* AB *cycloidi occurrens in* B, *ex quo ducatur recta* BC *curvæ Cycloidis* BD *in* B *normalis, ad quam ex* A *demittatur perpendicularis recta* AC. *Dico Tempus quo grave è quiete cadens ex* A, *vi ſuæ gravitatis decurrit rectam* AB, *eſſe ad Tempus quo percurrit Curvam* AVB, *ſicut recta* AB *ad rectam* AC.



Per B *ducatur* BL *parallela Cycloidis axi* VE; & BK, *baſi* AD *parallela, occurrens axi in* G, & *circulo ſuper Diametrum* EV *deſcripto in* F & H, *Cycloidi denique in* K. *Ducatur recta* EF, *quæ ex Cycloidis natura parallela*